# Writing about Research

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### The Title



- Should be around 7-8 words
  - Try to be precise and don't use words that are general catch-alls
- Think of want you would want others to Google to find your work
- You don't have to decide the title early on
  - The title should easily emerge after you've written the abstract
- Think of FUTURE PUBLICATIONS
  - Don't squeeze yourself out of your next title
  - Happens ALL the time

### The Abstract

- Almost everything comes with an abstract
- A very well-written 1/2/3-paragraph summary
- Luckily there is an expected structure:
  - 1. What is the area and why is it an important area?
  - 2. What is the problem that you tackle and why is it hard?
    - In as simple English as possible
    - Why are the challenges and why do they elude us?
  - 3. What does the literature say about this problem?
    - Results and shortcomings
  - 4. What is your approach in solving this problem?
    - How come you solved it?
  - 5. How do you implement your solution?
    - In simple, high-level English
  - 6. What are the key findings and the overall impact?
    - What you discovered
- Some of these are optional but it's a good idea to write too long an abstract and cut it down later (150 words)
- Passive/Active voice?

### The Abstract

The Abstract is a sanity check: If you can't write a compelling abstract, there is likely something wrong with your work
It's a plan for your argument
It's a story that you can tell to answer the question "So, what's your work about?"

## Writing Top-Down

- This is something I use and it works for me and has worked for my students
- Write 2/3 sentence that describes each section (in informal english)
- Searching
  - Section 1: "Fault-tolerance is a big issue for upcoming machines, and checkpointingrecovery is the typical approach. Finding the best checkpointing strategy is crucial and a well-studied question. In this work we make new contributions"
  - Section 2: "Previous works have studied this question in many ways and many results are available, but it turns out that X and Y are not well-known or studied, which is what we do"
  - Section 3: "Here is the definition of the problem, of the objective, and a statement of our assumptions"
  - Section 3: "We can compute the optimal checkpointing frequency and some cases, or have a dynamic programming approximation in general"
  - Section 4: "We use state-of-the-art simulation methodology, described here, to evaluate our work and compare it to those by X, Y, and Z.
  - Section 5: "Our results show that we rule in terms of expected application makespan"
  - Section 6: "The impact of our work is significant and
- Stop. Read. Discuss with co-authors. Check coherence
  - At this stage, it's often obvious but sometimes not

## Writing Top-Down

- Expand each sentence into a set of sections and sub-sections, summarize each section/sub-section with one sentence
- Example: "We can compute the optimal checkpointing frequency and some cases, or have a dynamic programming approximation in general"
  - 3.1. We remark that the problem can be written as a recursion, and we write it
  - 3.2 If failures are exponential, then Theorem 1 gives the solution to the recursion
    - Proof of the theorem
    - Give the closed-form solution and say that it's a major new result
  - 3.3 If failures are non-exponential, then we need a dynamic programming solution
    - Proof of correctness
    - Computational complexity
- Stop. Read. Discuss with co-authors. Check coherence
  - This is when first issues arise

# Writing Top-Down

- In each section write one sentence per paragraph, still informally
  - "Algorithm Y sucks"
  - We reuse the same methodology as in [12], but enhance it with a and b parameters"
- Stop. Read. Discuss with co-authors. Check coherence
   MANY ISSUES HERE: shuffling of sentences
- DO NOT get tempted to write full paragraphs until you have a full version
  - your co-authors/advisor will blow your wordsmithing to smithereens anyway
- Then, write 10 paragraphs a day and feel productive
  - Keep the informal sentences for each paragraph in comments (e.g., LaTeX comments)

#### • Tip #1: Every sentence should be factual and justifiable!

- This is supposed to be a rock-solid piece of work, no leaf unturned
- References at the end of sentences are a good thing
- e.g., "Computers are moving towards many-core architectures [12]"
- e.g. "This has never been considered before" -> "The authors are not aware of any other work where this has been considered
- "All other works apply the slow method" -> "In [2,4,8] the slow method is applied."

#### Tip #2: Avoid hyperbole

- Terms like "extremely," "very," "highly,"... should used rarely (never?)
- Be quantitative: "3 orders of magnitude larger," "within .5%," "in 95% of the cases," etc.
- Avoid all imprecision "almost," "soon," "seem," "probably,"...
- Avoid everything colloquial: "lots of," "huge,"
- Being vague is a major offense
- Tip #3: Get to the point quickly in the introduction
  - No "grandmothering" (bores experts, can't help non-experts enough anyway)

- Tip #3: A graph/table should not have too many embedded messages
  - Make sure these messages are clearly outlined
  - Itemized lists are always a good thing
- Tip #4: Each paragraph must describe a single idea
  - The first sentence links with the previous paragraph
  - The last sentence concludes and/or links with the next paragraph
- Tip #5: Your conclusion shouldn't just be the introduction in the past tense
- Tip #6: What about having "this paper is organized as follows. In Section 2 ..." paragraph at the end of the intro?
  - No idea what I think about this but some really hate it even though it's almost always there

#### Tip #6: Use your advisor!

- Your advisor wants you to have a good thesis
- You should get continuous feedback on the outline and the writing
- Being on the same page regarding the outline is absolutely necessary
- I love it when students give me the "top down approach" informal writing pieces
  - We detect problems early, when they're clear, rather than later once they are buried within pages and pages
- Tip #7: Set yourself writing deadlines
  - Defined with your advisor

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- Based on conference deadlines perhaps
- Tip #8: Overlap writing and research
  - As time goes by, you want to dedicate x half-days to writing per week, where x increases as time goes on
    - Start when you have enough for a chapter
  - Some students do all the writing at the end, but I don't think it's a good idea
    - It feels great to have a few written chapters
    - You get early feedback on your writing strengths/weaknesses
    - Doing only writing for weeks and weeks is really tough

- Tip #9: Start writing the "easy" sections
  - The introduction and conclusions are tough
  - The related work section shouldn't be too hard
  - The "meat" sections are typically the easiest
    - methodologies, graphs, and results are easier to write about than research vision
- Tip #10: After reading a paper you like, think about what you liked in terms of the writing and shamelessly steal writing techniques
- Tip #11: Add "sign-post" sentences
  - "In the previous section we saw that...."
  - "In this section we...."
  - "Up to now, our results indicate that.... but..."
  - Put TOO MANY of them, and remove them later

#### Tip #12: Use consistent terminology

- Pick a term for a concept, and stick to it!
- If you use "computer", don't start using "machine", "host", "processor", "node"
- If you use "framework", don't start using "environment", "infrastructure"
- If you use "approach", don't start using "scheme", "technique", "solution", "strategy"
- Synonyms are death
- You can be upfront about two terms used interchangeably if truly necessary
- Tip #13: Spell out conclusions from the data
  - Don't expect readers to go look at tables/graphs and figure anything out for themselves
  - Every figure/table should be referenced in the text
  - Describe axes/rows/columns meaning in the text
  - Have detailed captions (it's ok to have a multi-line caption)

- Tip #14: It's all about critical thinking, not describing data
  - Always bear this in mind when writing your "meat" sections
- Tip #15: Use jokes/spun sparingly (never?)
- Tip #16: Beware of the word "optimal"
  - Even worse is "more optimal", "most optimal"
  - More generally speaking, know when a term is loaded
- Tip #17: Use the present tense as much as possible
  - No "In Section 4 it will be shown that..."
- Tip #18: Good grammar and good style are important
   There are books to help you (e.g., "The elements of style")
- Tip #19: Consistency, consistency, consistency
  - We've seen consistency of terms, but it applies throughout
    - Graph scales, orders of curves, style of bullets, infinitive vs. -ing, tenses, etc.
- Tip #20: Spellcheck!

There is much on-line material on this topic
 general or CS-specific

A good list of 68 tips: <a href="http://www.cs.columbia.edu/~hgs/etc/writing-bugs.html">http://www.cs.columbia.edu/~hgs/etc/writing-bugs.html</a>
 Tips 1, 4 (overuse it at first), 21 (make a removing pass), 27, 32, 48, 58 (personal pet peeve), 64,

# Writing Meta-Tips

Meta-Tip #1: Thinking that we're not in an English dept. and the only thing required is to read binary and write assembly is not a fair assessment

Writing in research is sickeningly important

Meta-Tip #2: Ignoring all writing tips, forging ahead, and applying tips at the end will only result in pain and suffering

- And not only your own pain and suffering, but that of your advisor, the person that should be your advocate at your defense
- Many defenses private deliberation: "Writing was like pulling teeth and I almost lost my sanity"
- Meta-Tip #3: Thinking that my list of Tips is sufficient for all advisors is a mistake
  - But it's hopefully a good start

### A Note on Critical Thinking

- Too often authors do not show critical thinking in their writings
  - Extreme case: Ph.D. portfolio literature reviews
- When describing related work and your own contribution, critical thinking is key
- The thing to do: compare previous work and your work in terms of strengths and weaknesses
- Be assertive, and 100% factual
- Your reader should be able to engage in discussions in your area of research
  - Well, yes, Algorithm X is great but it doesn't work when Y happens" ("Am I happy I read that paper that had such a clear critical analysis of the state of the art")
- But always be civil and not disparaging
  - Even if you think that some work is of poor quality

# Writing "workshop"

I've selected 1 example of bad writing
Early draft of an abstract and an introduction
From a paper on sensor networks
I'll send it to the ICS690 mailing list for us to read
Then we'll "fix it" in class

### The End

Questions?
Comments?
Personal Stories?